FEDERAL REPUBLIC OF GERMANY

GERMAN PATENT OFFICE

Int.Cl. E 04 c, 1/68

German Cl.: 37 b, 1/68

Laid Open Application 1 901 206

File Number:	P 19 01 206.7
Filing date:	January 10, 1969
Laid open date:	November 6, 1969

Ausstellungspriorität [Exhibition priority]:	—
Convention priority	
Date:	January 11, 1968
Country:	Sweden
File number:	382-68

Title:	Plate or slab-form building element
Addition to:	—
Division from:	—
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Notification pursuant to Article 7, Section 1 (2) No. 1 of the Law of 9/4/1967 (*BGBl.* [*Bundesgesetzblatt*, Federal Gazette] I, p. 960): —

DT 1901206

A 569

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January 10, 1969

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Plate or Slab-Form Building Element

The present invention relates to non-combustible, water-resistant and frost-resistant plates or slabs for building purposes. Its primary object is to provide building plates that can be used for the same purpose as the currently known wood fiberboards, wood particleboards, gypsum boards and the like. A further object, however, is to provide a plate or slab-form building element that can be produced with substantially larger dimensions, so that it can be used as a wall element for both interior and exterior walls. Neither the known wood fiberboards and particleboards nor the known gypsum boards are water-resistant or frost-resistant. Wood fiberboards and wood particleboards are also combustible, while gypsum boards have relatively low bending strength.

The object of the invention is therefore to provide a building board that is both non-combustible and water and frost-resistant, has high bending strength and nevertheless low weight.

The plate or slab-form building element according to the invention is characterized by a largely porous core held together by a hydraulic binder and, on each side of this core, an impermeable binder layer, which is substantially thinner than the core and is at least partially reinforced with fibrous material, and an outermost plastic layer.

The central core of the building element preferably consists of foamed concrete or foamed gypsum, which is reinforced with a non-combustible inorganic

fibrous material such as mineral wool or asbestos, for example, and contains an addition of one or more synthetic water-insoluble polymers such as, for example, polyvinyl chloride, polyvinyl acetate, polyvinylidene chloride, polyacrylate, epoxy, polyester, polystyrene butadiene or copolymers of these materials, which are capable of binding the mineral fibers and of increasing the tensile strength of the concrete or gypsum. As an alternative, particularly in thicker slabs intended to be used as wall elements, the core may consist of grains or globules of a porous filler, preferably expanded calcined clay held together by cement or gypsum.

The fiber-reinforced, impermeable binder layers on both sides of the core preferably consist of unfoamed cement or gypsum with an addition of a synthetic water-insoluble polymer such as, for example, polyvinyl acetate, polyvinyl chloride or polyvinylidene chloride, which is capable of binding the fiber reinforcement and of increasing the tensile strength of the cement or gypsum. The fiber reinforcement may consist of short fibers having any orientation, or of a fibrous fabric. Suitable fibrous materials are, for example, jute, diabase, asbestos or glass fibers. Preferably, the fiber reinforcement in this impermeable cement or gypsum layer reinforced with synthetic polymer also extends into the outer plastic layer, such that the plastic layer is likewise fiber-reinforced. The outermost plastic layer may advantageously consist of polyethylene, urea, melamine, epoxy or polyester.

Alternatively, the fiber-reinforced, impermeable binder layers on both sides of the central core may consist of fiber-reinforced plastic layers consisting of the same plastic as the outermost plastic layers. In this case, the fiber

reinforcement in these fiber-reinforced plastic layers preferably also extends somewhat into the central core.

The central, mainly porous core of the plate or slab-form building element according to the invention imparts the necessary rigidity and compressive strength to the element. The fiber-reinforced impermeable binder layers on both sides of the core impart the desired high bending strength to the element and render the porous core impermeable to water. The outermost plastic layers of the building element render the element completely waterproof and moisture-proof. These plastic layers also impart a weatherproof surface of attractive appearance to the element, which requires no maintenance. These plastic layers may be colored in a manner known per se to give the element the desired color. It is also possible to mix mineral grains or the like into the outermost plastic layers to obtain particular esthetic effects.

Due to the above-described selection of materials in the different parts of the building element according to the invention, the element obviously becomes non-combustible. Since the central core, which makes up the greater part of the building element, is predominantly porous, the building element is also relatively low in weight and has relatively good heat insulating and sound insulating properties.

The invention will now be described in greater detail with reference to the attached drawing and some exemplary embodiments of the production of an element according to the invention.

Figure 1 of the drawing is a schematic cross-sectional view of a first embodiment of a building element according to the invention, while Figure 2 correspondingly illustrates another embodiment.

The plate or slab-form building element according to the invention as schematically illustrated in cross-section in Figure 1 has a central core 1 which makes up the greater part of the thickness of the building element. This core is largely porous and is held together by a hydraulic binder such as, for example, cement or gypsum. The core 1 preferably consists of foamed cement or foamed gypsum having a reinforcement consisting of mineral fibers and an addition of a synthetic water-insoluble polymer, which binds the fiber reinforcement and increases the tensile strength of the cement or gypsum. The core may also consist of a filler, which is held together by cement or gypsum and consists of grains or globules of expanded calcined clay. For thin plates intended to be used for the same purpose as the known wood fiberboards, gypsum boards and similar building boards, the core 1 may have a thickness of, for example, 5–20 mm. In the case of thicker building elements, which may be used as wall elements, the core 1 may have a thickness of, for example, 50–200 mm. On either side of the central core 1 there are impermeable fiber-reinforced layers 2 of cement or gypsum with an addition of a synthetic water-insoluble polymer, which is capable of binding the fiber reinforcement and of increasing the tensile strength of the cement or gypsum. The fiber reinforcement may consist of short fibers having any orientation, for example, of diabase, glass wool, asbestos or the like, or of a fabric of a fibrous material, for example, a jute fabric or a glass fiber fabric. These impermeable, fiber-reinforced cement or gypsum layers reinforced with polymeric

material may have a thickness of, for example, 1–10 mm depending on the total thickness of the building element.

On the outermost part, two thin plastic layers 3 are provided which consist of, for example, polyethylene, urea, melamine, epoxy or polyester. These plastic layers may be completely unreinforced, or the fiber reinforcement in the inner fiber-reinforced, impermeable cement or gypsum layers 2 may also extend into the outer plastic layers 3, such that the latter are likewise partially fiber-reinforced. The outermost plastic layers 3 may be colored in a manner known per se or may contain mineral grains, so that the desired appearance of the surface of the building element is obtained. These outermost plastic layers 3 may have a thickness of, for example, 0.1–3 mm, depending on whether they are fiber-reinforced or not.

The building element according to the invention schematically depicted in Figure 2 contains a central core 1 of the same type as the building element illustrated in Figure 1. In this case, the core 1 is surrounded on both sides by fiber-reinforced plastic layers 4 whose fiber reinforcement preferably also extends somewhat into the core 1 and which therefore form both impermeable, fiber-reinforced binder layers corresponding to the layers 2 in the building element according to Figure 1 and outer plastic layers on the surfaces of the building element corresponding to the plastic layers 3 of the building element according to Figure 1.

A building element having the construction illustrated in Figure 1 may be produced, for example, in the following manner:

1. A thin layer of fibers, which have any orientation and are either free or somewhat bound together, for example, diabase, glass wool or asbestos fibers, or a fabric, for example, a jute fabric or a glass fiber fabric, is applied to a mold or

another suitable substrate. The weight per unit area of this fiber layer is, for example, 100–200 g/m^2.

2. A cement or gypsum mass, which contains an aqueous emulsion of a synthetic water-insoluble polymer such as, for example, polyvinyl acetate, polyvinyl chloride or polyvinylidene chloride, and which is capable of binding the fibers and increasing the tensile strength of the gypsum or cement mixture, is poured onto this fiber layer. For example, a cement mass may be used which contains 74% by weight of cement, 24% by weight of water and 2% by weight of polyvinyl acetate emulsion (approximately 50% dry substance).

3. The mold or substrate is shaken, so that the cement or gypsum mass penetrates into the fiber layer.

4. A mass of foamed concrete or foamed gypsum, which forms the core of the building element and contains a fiber reinforcement and an addition of synthetic water-insoluble polymer, is poured onto the fiber-reinforced impermeable cement or gypsum layer according to Point 3. This mass of foamed concrete or foamed gypsum is preferably produced by vigorously agitating an aqueous emulsion of a synthetic water-insoluble polymer, or a mixture of such polymers, for example, polyvinyl chloride, polyvinyl acetate, polyvinylidene chloride, polyacrylate, epoxy, polyester or polystyrene butadiene, containing approximately 1–10%, preferably 2–6% by weight of polymer and approximately 1% by weight of a wetting agent, for example, sodium alkyl sulfonate, and optionally a foam stabilizer, for example, carboxymethylcellulose, so that a stable water-polymer foam is obtained. Approximately 2–20% by weight of mineral fibers, for example, mineral wool or asbestos, are dispersed in this foam or during

production of the foam. While agitating more slowly, cement or gypsum are added to obtain a final water-to-cement or water-to-gypsum ratio of preferably approximately 0.5–0.6, or possibly less, depending on the desired density.

Instead of such a mass consisting of foamed concrete or foamed gypsum, a mixture of cement or gypsum, water and a filler consisting of grains or globules of expanded calcined clay may be used for the core, such that the core of the building element consists of a filler of expanded calcined clay bound by cement or gypsum.

5. A thinner layer of cement or gypsum, water and synthetic polymer according to Point 2 is poured onto the layer according to Point 4.

6. A thin mat of mineral or glass fibers having any orientation and being somewhat bound together, or a jute fabric or glass fiber fabric is applied to the layer according to Point 5 and preferably pressed into this layer. Alternatively, the step according to Point 5 may be omitted, in which case the fiber mat or the fiber fabric is instead first impregnated with a cement or gypsum mass according to Point 2.

7. The plate or slab-form element produced in the described manner is preferably hardened at a temperature of approximately 50–70°C.

8. After hardening of the hydraulic binder in the building element and evaporation of the excess water, the two surfaces of the element are coated or impregnated with a plastic, which is optionally colored or mixed with mineral grains. This may be done by spreading or spraying the plastic in dissolved form onto the two surfaces of the element. For this treatment, a clear urea varnish with

aluminum chromium orthophosphate as hardener, an epoxy varnish or a mixture of polyester (70%) and polystyrene (30%) and a hardener are used. Particularly if melamine is used, the plastic may also be applied to the two surfaces of the element in the form of a fine powder, which is then melted to form a plastic layer by passing the element between hot rollers. Alternatively, the partially fiber-reinforced outermost plastic layers may be produced on the two surfaces of the building element by introducing a thin layer of mineral or glass fibers between two polyethylene foils. An endless web of layers thus arranged is passed between heated rollers, such that the fiber layer is bound between the polyethylene layers on either side. Thereafter, the polyethylene foils are pulled apart to obtain two polyethylene foils having fibers adhering to one side. These polyethylene foils having a fiber layer on one side may be used instead of the fiber layers described in the foregoing Points 1 and 6. In this case it is therefore not necessary to apply any outer plastic layers to the surfaces of the element after the element has been produced.

A building element according to Figure 2 may in principle be produced in the described manner, but in this case the permeable cement or gypsum layers containing a synthetic polymer according to Points 2 and 5 are omitted. Instead, the outer plastic layers are produced with a greater thickness, and it is ensured that they are reinforced with a fiber reinforcement, which preferably also extends somewhat into the core of the building element.

WHAT IS CLAIMED IS:

1. Plate or slab-form building element, characterized by a core which is largely porous and is held together by a hydraulic binder and, on both sides of this core, a binder layer which is substantially thinner than the core, is impermeable and at least partially reinforced with a fiber material, and an outermost layer of a synthetic plastic.

2. Building element as claimed in Claim 1, characterized in that said core consists of foamed concrete or foamed gypsum with an addition of one or more synthetic water-insoluble polymers such as, for example, polyvinyl chloride, polyvinyl acetate, polyvinylidene chloride, polyacrylate, epoxy, polyester, polystyrene butadiene or copolymers of these materials, and having a reinforcement of a non-combustible, inorganic fiber material such as, for example, mineral wool or asbestos.

3. Building element as claimed in Claim 2, characterized in that said core, calculated relative to the quantity of cement or gypsum, contains approximately 1–10% by weight of fiber material and approximately 0.5–5% by weight of polymeric material.

4. Building element as claimed in Claim 1, characterized in that the core consists of grains or globules of expanded calcined clay, which are held together by cement or gypsum.

5. Building element as claimed in any one of Claims 1 to 4, characterized in that the binder in the impermeable binder layer reinforced with fiber material consists of cement or gypsum.

6. Building element as claimed in Claim 5, characterized in that the fiber-reinforced impermeable cement or gypsum layer contains a synthetic water-

insoluble polymer such as, for example, polyvinyl acetate, polyvinyl chloride or polyvinylidene chloride, which is capable of binding the fiber reinforcement and increasing the tensile strength of the cement or the gypsum.

7. Building element as claimed in Claim 5 or 6, characterized in that the fiber reinforcement also extends into the outer plastic layer.

8. Building element as claimed in any one of Claims 1 to 4, characterized in that the binder in the fiber-reinforced, impermeable binder layer consists of the same plastic as the outermost plastic layer.

9. Building element as claimed in Claim 8, characterized in that the fiber reinforcement in the impermeable fiber-reinforced binder layer also extends into the core.

10. Building element as claimed in any one of Claims 1 to 9, characterized in that the fibrous material in the impermeable, fiber-reinforced binder layer consists of short fibers having any orientation, or a fabric of, for example, jute, diabase, asbestos or glass fibers.

11. Building element as claimed in any one of Claims 1 to 10, characterized in that the outermost plastic layer consists of polyethylene, urea, melamine, epoxy or polyester.

Fig. 1

[See original for art.]

Fig. 2

[See original for art.]

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Fig. 1

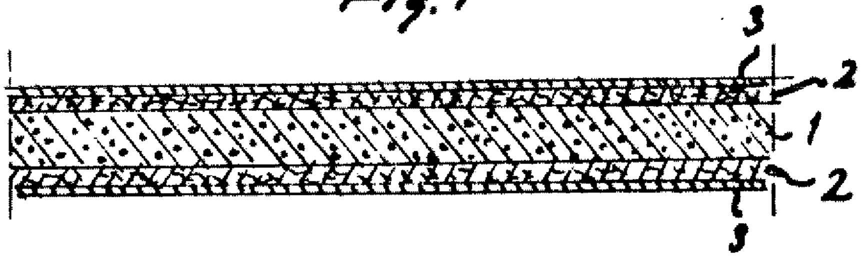

Fig. 2